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DESCRIPTIONS OF NEW AND CRITICAL NOTES UPON PREVIOUSLY KNOWN FORMS OF NORTH AMERICAN OEDIPODINAE (ORTHOPTERA; ACRIDIDAE)

Second Paper

BY JAMES A. G. REHN

In the first paper of this series[1] we have presented some prefatory matter that applies with equal force to the present contribution, which represents a continuation of the same study.

A critical study of the forms which have been referred to the genus *Circotettix* by various authors has resulted in the accumulation of much information, a portion of which, however, will require more definite correlation with the entities which have been referred to the genus *Trimerotropis*. This will be done in the very near future. At this time we are presenting, solely, such critical comments brought forth by our work on the Circotettigine section of the study, as it seems desirable to publish in advance of the entire revision.

The Generic Position and Geographic Races of Oedipoda carliniana Thomas (Circotettix carlinianus of Authors)

A critical examination of the species which have been referred by authors to the genus *Circotettix*, shows most conclusively that we have a number of aggregations represented in that assemblage, and of these but few show sufficient affinity to be retained in restricted *Circotettix*, the genotype of which is, as originally stated by Scudder,[2] *Oedipoda undulata* Thomas. I have been fortunate enough to be able to examine the unique type specimen of *undulata*, in the United States National Museum, and its real identity had not been suspected by any recent workers. We will discuss this on a succeeding page.

The first section which it is necessary to segregate is that containing the forms of the *carlinianus* type. This we find to represent a valid genus, showing slightly more affinity with the

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[1] Trans. Amer. Entom. Soc., XLV, pp. 229 to 253, pls. XXVI to XXVIII, (1919).

[2] Bull. Geol. and Geogr. Surv. Terr., II, p. 265, (1876).

Old World genus *Bryodema* Fieber,[3] than with true *Circotettix*. Of *Bryodema* we have before us a male of *B. tuberculata*,[4] which is a species very closely related to the genotype (by monotypy), *B. baicalensis* Fischer. The similarity of wing structure and venation of *Bryodema* and the new genus is startling.

AEROCHOREUTES[5] new genus

A genus sharing features of the Old World genus *Bryodema* Fieber and the North American *Circotettix*, but in the bulk of its characters nearer *Bryodema* than *Circotettix*. From *Bryodema* the present genus can be distinguished by the smooth genae (these substrumose in *Bryodema*) and the strangulate pronotum, which also has the prozona equal to about one-half the length of the metazona, the transverse sulci deeply impressed and the lateral lobes deeper than dorsal length of same. In *Bryodema* the pronotum is heavier, the disk more quadrate, the prozona about three-fifths as long as metazonal disk, the transverse sulci are relatively weakly impressed and the lateral lobes with greatest depth subequal to dorsal length of same. From *Circotettix* the new genus differs chiefly in having the wings non-papilioniform, all the superjacent radials of the same incrassate, instead of but a portion of the series, and the fastigium broader than long in the male sex. In all these features it is in accord with *Bryodema*.

Generic Characters.- Fully alate in both sexes. Form robust. Fastigium broad, width at least as great as length: frontal costa broad, sulcate ventrad of median ocellus; face subvertical in profile. Pronotum short, broad across metazona, moderately strangulate on prozona; prozona not exceeding one-half of length of metazonal disk; caudal margin of disk rectangulate; transverse sulci deeply impressed: lateral lobes of pronotum with depth greater than dorsal length of same. Tegmina surpassing apex of abdomen and apices of caudal femora, broad, coriaceous; marginal field broad; intercalary vein evident. Wings equal to tegmina in length; radiate field regular in type, non-papilioniform, peripheral margin of same but faintly or at most weakly sinuato-lobulate: anterior axillary vein weakly incrassate, not fusing with the posterior axillary vein; all superjacent radiate veins incrassate.

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[3] Lotos, III, p. 129, (1853).

[4] Desert of Khorinskaya, Transbaikalia, Siberia. (Parschine.) [Hebard Collection.]

[5] From ἀήρ *air*, and χορευτής *choral dancer*.

Genotype—*A. carlinianus* [*Oedipoda carliniana*] (Thomas).

Aerochoreutes carlinianus (Thomas)

1870. *Oe*[*dipoda*] *carliniana* Thomas, Proc. Acad. Nat. Sci. Phila., 1870, p. 81. [♂ ♀; Eastern Colorado.]

The genus is composed of one species, which is divisible into two well-marked geographic races, each occupying a considerable territory and their intergradation demonstrated in the material before us. Of these races, one (*carlinianus carlinianus*) is eastern and northern, occurring in the northern Great Plains, northern Rocky Mountains and central British Columbia, while the other, which is new (*carlinianus strepitus*), is a form of the Great Basin and Green River regions. The area of intergradation is discussed below.

Aerochoreutes carlinianus carlinianus (Thomas) (Plate XI, figs. 1 to 3.)

We have taken material from Fort Collins, Colorado, as typical of this race.

This, the typical subspecies of *carlinianus*, when compared with *A. carlinianus strepitus*, described below, is characterized by having the general form shorter and proportionately more robust; tegmina broad and less attenuate, particularly at apices; wings less elongate and not subfalcate distad, the alar ulnar area relatively narrow, no wider than median area at distal three-fifths, interaxillary area of wings relatively broad and subequal in width; eyes proportionately smaller, less prominent when seen from the dorsal and cephalic aspects, and more ovoid and less elliptical in basal outline, the ventral margin approximately subangulate; fastigium proportionately broader. The figures illustrating these remarks present the differences more clearly than words. In the description of *A. carlinianus strepitus* we have presented an analysis of the differential features of that race, which will aid in the proper segregation of the two forms.

Aerochoreutes carlinianus carlinianus is a form of the higher Great Plains region, extending into the Rocky Mountains, typical material before us representing localities extending from as far north as Garrison, Montana, south to Gray Creek, Colorado, east to Powderville, Montana, and Hecla, Wyoming. Atypical material showing weak tendencies toward the new subspecies is available from Blue Lake, Grand Coulee, Washington; Shoshone, Salmon City, Birch Creek, Springfield, Pocatello and Soda Springs, Idaho; Bozeman, Montana and Mammoth Hot Springs, Yellowstone National Park. Actual intermediates between the two races are before us from Chilcotin, British Columbia; La Chapples, Yakima River, Washington, and Salt Lake Valley, Utah. When the distribution of typical *carlinianus* is compared with that of the subspecies *strepitus*, it will be seen that the former is a more northern and eastern type, and that it is not stable nor fully typical in the Snake River country of Idaho. It is also in a stage of what might be called equal fusion with *A. c. strepitus* in regions as related to the Snake River country as the Salt Lake Valley district, and to the Great Basin region as the Columbia Plains (Yakima River) and the dry interior of British Columbia (Chilcotin).

Aerochoreutes carlinianus strepitus[6] new subspecies (Plate XI, figs. 4 to 6.)

A strikingly marked geographic race of *carlinianus*, in its typical form inhabiting the Great Basin and Green River regions, differing from typical *carlinianus*, as delimited above, in the following features: Eyes larger, more prominent when seen from the dorsal and the cephalic aspects; tegmina longer and more slender, relatively quite slender at apices; wings elongate, anterior and axillary fields much produced, apical section subfalcate; ulnar area of wings wider than in *carlinianus carlinianus*; interaxillary area of wings relatively narrow. These features are more accentuated in the male than in the female sex.

Type.—♂; Prince Royal Canyon, Star Peak Range, Humboldt County, Nevada. Elevation, 4500 to 5000 feet. September 16, 1919. (Rehn and Hebard.) [Hebard Collection, Type no. 766.]

The following features are chiefly comparative with *A. c. carlinianus*.[7] Form more elongate, due to greater length of tegmina and wings. Head with eyes more prominent from dorsum and from cephalic aspect, in latter view weakly but apparently elevated above level of fastigium: fastigium proportionately narrower: eyes in basal outline, in lateral view, deeper and more elliptical, less sharp ovoid ventrad. Pronotum with strangulation slightly less marked: caudal angle of disk less acute produced and subrectangulate. Tegmina surpassing apex of abdomen by approximately the dorsal length of pronotum, and surpassing apices of caudal femora by approximately the combined length of head and pronotum, in shape more elongate with distal section moderately attenuate. Wings more falcate attenuate distad (see figure 4), apex of axillary field much more obliquely arcuato-lobulate: posterior ulnar area broad, the ulnar vein moderately sigmoid and not subparallel to anal vein as in typical *A. c. carlinianus*, ulnar area at three-fifths of length nearly twice as wide as adjacent portion of median area: interaxillary area relatively narrow compared with post-axillary area, narrowest point at two-thirds of wing length: radiate field of wing with margin more evidently sinuato-lobate.

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[6] Strepitus, *clattering*.

[7] Comparisons made with male from Fort Collins, Colorado, (Dyar and Caudell), [Hebard Cln.].

Allotype.—♂; Same data as type. [Hebard Collection].

The female sex shows the same characters of differentiation as the male sex, although to a slightly less marked degree.

The coloration of the species as a whole will be discussed at a later date in a study of this and related genera. No marked color features differentiate the new subspecies. The infuscate area present on the proximal section of the wing in the majority of specimens of *A. carlinianus carlinianus* is rarely indicated in *A. c. strepitus*, but it is by no means a fixed feature in series of typical *carlinianus* and is not a diagnostic feature of that subspecies. In *car. carlinianus* from Garrison, Montana, it may be evident or absent. In atypical individuals of the same form from the Snake River region, Idaho, it is almost always absent, and here conditions of aridity nearer akin to those prevalent in the area of distribution of *A. c. strepitus* may be the cause. At all events the presence or absence of wing cloud infuscation is not a subspecific feature in this species. In the series of *strepitus* we find the wing cloud weakly indicated in one topotype and more evident in one female from Wells, Nevada, tendencies or evident clouds indicated in all or nearly all from Green River, Wyoming; Grand Junction, Colorado, and Milford, Utah. This clouding is entirely independent of the pronounced pencilling of the radiate veins of the wing, which is found without exception in all specimens of the species.

Measurements (in millimeters)

	Length of body	Length of pronotum	Length of tegmen	Length of caudal femur
A. car. carlinianus				
♂, Fort Collins, Colorado...........	32	7.3	27.8	14.6
♂, Fort Collins, Colorado...........	31.5	8	28	14.8
♂, Garrison, Montana..............	25	6.4	24.4	12.7
♂, Garrison, Montana..............	29.3	7	25.5	13.4
♀, Fort Collins, Colorado...........	33.8	7.8	30.5	15.5
♀, Garrison, Montana..............	32.3	7.4	29	14.6
♀, Garrison, Montana..............	34	7.5	27.9	15

	Length of body	Length of pronotum	Length of tegmen	Length of caudal femur
A. car. strepitus				
♂, Prince Royal Canyon, Nevada, *type*	30.5	6.9	30.7	14.5
♂, Prince Royal Canyon, Nevada, *paratype*	30	7	31	14
♂, Prince Royal Canyon, Nevada, *paratype*	33.7	7.4	33.2	15.3
♂, Grand Junction, Colorado	31.5	7	32.2	15
♀, Prince Royal Canyon, Nevada, *allotype*	37.4	7.9	34.2	16.2
♀, Prince Royal Canyon, Nevada, *paratype*	34.5	6.6	30.2	14.6
♀, Prince Royal Canyon, Nevada, *paratype*	37.2	8	36.2	16
♀, Grand Junction, Colorado	39.2	8.1	36.7	17.5

We have selected as paratypes a series of twenty-eight males and twenty-five females from the type locality. Aside from one female, which shows some approximation to *A. c. carlinianus* in wing characters, this series is uniform and thoroughly typical of the new subspecies. This one individual exhibits one of the reversal tendencies occasionally seen in individuals of almost any geographic race, when extensive series are examined, and which are clearly explicable as genetic influences. It is possible that *strepitus* is a more recent type than *car. carlinianus*, as its present area of distribution in large part was occupied in recent geologic times by Lakes Bonneville and Lahontan. It is equally possible that originally it was driven into the basin ranges by these bodies of water, and that by the process of survival individuals with longer wings, and probably better power of flight, formed the beginnings of this race, which may have repopulated the flat lands and valleys when the lakes subsided through evaporation.

The new subspecies is a Great Basin and Green River Valley form, typical east to Grand Junction, Colorado; north to Green River in Wyoming, Montello, Wells, Carlin and the Star Peak Range in Nevada, the only locality to the southward represented in the material before us being Milford, Utah. Atypical *strepitus* is before us from North Park, Colorado; Laramie, Rawlins and

Worland, Wyoming. Intermediates between the two races have been discussed under *A. c. carlinianus*. The occurrence of atypical *strepitus* at Worland, in the Big Horn Valley, at Rawlins, Wyoming, and North Park, Colorado, on the plains of the upper North Platte, and at Laramie on the Laramie Plains, is correlated with the known occurrence of Great Basin influences in the Big Horn Valley and the upper North Platte region.

Specimens Examined: 141; 67 ♂, 74 ♀.

Typical *A. carlinianus strepitus*

Wyoming: Green River, Sweetwater County, elevation 6050 to 7000 feet, VIII, 3, 1910, (R. & H.; on bare ground between scattered sage and other bushes on flats and talus slopes of valley rim), 2 ♂, 4 ♀.

Colorado: Grand Junction, Mesa County, elevation, 4700 to 4800 feet, IX, 8, 1909, (R. & H.; on bare ground with scattered chenopodaceous bushes and very sparse grass), 1 ♀; no date, 2 ♂, 2 ♀, [Hebard Cln.].

Utah: Tintic, Juab County, elevation, 4500 feet, IX, 6, 1909, (R. & H.; among stones on bare slope), 1 ♂. Milford, Beaver County, elevation 4900 to 5000 feet, IX, 5, 1909, (R. & H.; on bare ground between scattered sage brush), 4 ♂, 7 ♀.

Nevada: Montello, Elko County, IX, 19, 1919, (R. & H.; on alkali encrusted adobe flat with scattered *Sarcobatus* bushes, one individual only seen), 1 ♂. Wells, Elko County, IX, 18, 1919, (R. & H.; very few in open spots among sage on adobe plain rising to foothills), 5 ♀. Carlin, Elko County, IX, 17, 1919, (R. & H.; on bare soil with small rock fragments on low rounded sage brush clothed hills), 1 ♂, 2 ♀. Prince Royal Canyon, Star Peak Range, Humboldt County, elevation 4500 to 5000 feet, IX, 16, 1919, (R. & H.; common and noisy on canyon slopes, these chiefly of blue gray limestone with scattered sage cover), 29 ♂, 26 ♀, *type*, *allotype* and *paratypes*.

Atypical *A. carlinianus strepitus*

Wyoming: Worland, Washakie County, VII, 10 to 15, 1911, VIII, 1911, some no date, (L. Bruner), 18 ♂, 14 ♀, [Hebard Cln.]. Rawlins, Carbon County, elevation 6750 to 6850 feet, VIII, 2, 1910, (R. & H.; locally on nearly bare adobe plain), 5 ♂, 8 ♀. Laramie, Albany County, 2 ♀, [Hebard Cln.].

Intermediates between *A. carlinianus carlinianus* and *A. carlinianus strepitus*

British Columbia: Chilcotin, VII, 16, 1920, (E. R. Buckell), 2 ♂, 2 ♀, [A. N. S. P.].

Washington: La Chapples, Yakima River, VII, 16, 1882, 1 ♂, [Hebard Cln.].

Utah: Salt Lake Valley, 1878, 1 ♂, 1 ♀, [Hebard Cln.].

The Groups of the Genus Circotettix

The genus *Circotettix*, as now limited, is composed of five sections, which may be referred to as (1) the Undulatus Group, (2) the Rabula Group, (3) the Crotalum Group, (4) the Thalassinus

Group and (5) the Shastanus Group. The first of these contains solely *C. undulatus* (Thomas), while the fourth is made up of the single species *thalassinus* Saussure. The Shastanus Group is composed of two species, *shastanus* Bruner and *splendidus* Rehn and Hebard, the exact relationship of which species is under investigation. The Rabula Group is more complex and is treated in detail below, where also we have given a section on the Crotalum Group. Quite a few of the species which have been referred to the genus *Circotettix* we now know do not belong to that genus, but their exact affinities are not easily determined, and investigations along these lines are now in progress.

The Identity of Oedipoda undulata Thomas, Genotype of the Genus Circotettix

In the collection of the United States National Museum there is a female specimen labelled "Oedipoda undulata. Col.Terr. Type." This individual has been dried from alcohol and it is type number 1088 U. S. N. M. There is every reason to believe this is one of the original specimens and in all probability the only one extant. Fully agreeing with the description as it does, its selection as the lectotype of the species is thoroughly justified. Thomas gave no indication of the number of specimens examined by him, although he supplied measurements of both sexes. This specimen shows that the following synonymy is necessary.

Circotettix undulatus (Thomas)

1872. *Oe[dipoda] undulata* Thomas, Ann. Rep. U. S. Geol. Surv.,v, p. 460. [♂ ♀; "Colorado and Wyoming east of the mountains."]

1888. *C[ircotettix] lobatus* Saussure, Addit. Prodr. Oedipod., p. 65, pl. fig. 5. [♀; Colorado.]

1890. *Circotettix lapidicolus* Bruner, Proc. U. S. Nat. Mus., XII, p. 75. [♂ ♀; (Salmon River Mountains west of) Salmon City, Idaho.]

1900. *Circotettix thalassinus* Scudder, Psyche, IX, p. 138. (Not of Saussure.)

The synonymy of *lobatus* and *lapidicolus* was correctly made by Scudder.[8] The type material of *lapidicolus*[9] is now before us, from the Hebard Collection, and the synonymy is beyond question. Saussure's erection of *lobatus* was in every probability due to Scudder's wrong interpretation of *undulatus*, which has been universally followed. Saussure had the two species before him, but unfortunately he described the wrong one. Scudder's interpretation of *thalassinus* is incorrect, a Nevada specimen so labelled and referred to by him now being before us. The greenish blue tinge of the wings in this and certain other individuals probably misled him. True *thalassinus* is a very different species of which we have studied considerable series.

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[8] Psyche, IX, p. 138, (1900).

[9] See Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1912, p. 66, (1912).

The Rabula Group of the Genus Circotettix

This group is made up of a single widely distributed species, ranging from Canada to southern New Mexico in the Cordilleran and adjacent regions, and divisable into three geographic races, one of which is new.

Circotettix rabula Rehn and Hebard (*Circotettix undulatus* of most authors, not of Thomas.)

1906. *Circotettix rabula* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1906, p. 393, figs. 13 and 14. [♂ ♀; Mammoth Hot Springs, Yellowstone National Park, Wyoming.]

The three geographic races of this species are as follows:

Circotettix rabula rabula. A northern form occurring in the United States in the Transition and upper portion of the Upper Sonoran Zones from Montana to Colorado, in Canada ranging into the Boreal Zone.

Circotettix rabula nigrafasciatus. A form occurring over a considerable portion of the Upper Sonoran Great Plains in South Dakota, Nebraska, Colorado and Kansas.

Circotettix rabula altior new subspecies. A form of the Boreal Zone within the United States, typical from northern Colorado to southern New Mexico.

Intergradation between these races is established by the extensive material before us, summarized discussion of which is given below.

Circotettix rabula rabula Rehn and Hebard (Plate XI, figs. 7 to 9.)

This the typical race is characterized within the specific assemblage by having a generally weaker and more broken wing-band than in *C. rabula nigrafasciatus*, shorter and broader wing than in same, with an average blunter apex; broader tegminal apex and more heavily incrassate radiate veins of the wing. From *C. rabula altior* the present race differs in the proportionately larger head, larger general size, broader fastigium, in the pronotum being as an average broader cephalad and less decidedly deplanate caudad on disk, lateral angles hardly marked on metazonal disk; caudal tibiae usually pale.

Single Type.[10]—Figured ♀; Summit of hills at head of Mammoth Hot Springs, Yellowstone National Park, Wyoming; elevation, 7000 feet. August 8, 1904. (M. Hebard.) [Hebard Collection, Type no. 72.]

Fully typical material of this subspecies is before us from localities extending from Glenora, British Columbia (58° N, 131° W), south to northern Colorado (Dutch George and Virginia Dale) and northern Utah (Ogden Canyon, City Creek Canyon, Salt Lake Valley and Logan); west to eastern Idaho (Salmon City and Henry Lake), east to eastern Montana (Glendive and Powderville). Atypical material showing tendencies toward *C. rabula nigrafasciatus* is present from northeastern Wyoming (Newcastle) and northwestern Nebraska (Bad Lands of Sioux County and Gordon); similarly graded material showing tendencies toward *C. rabula altior* is before us from Hecla, Wyoming, and Maple Peak, Salt Lake County and Cedar Mountains, Iron County, Utah. Material intermediate between *C. rabula rabula* and *C. rabula nigrafasciatus* represents localities in southern Manitoba (Aweme and Treesbank) and the Black Hills region of South Dakota. Similarly intermediate material between *C. rabula rabula* and *C. rabula altior* is from extreme southern Montana (West Gallatin Canyon), the Big Horn Mountains, Wyoming, southwestern Wyoming (Grade Canyon), northern (Park City) and eastern (Sierra La Sal) Utah, and southwestern Colorado (Dolores). It is necessary to have a clear conception of the topography of the country involved, to appreciate the relativity of the localities illustrating the intergradation of *C. rabula rabula* and *C. rabula altior*. This is due to the fact that the former occurs at lower elevations and over broader expanses of country, while *altior* is typically a form of circumscribed distribution in country of considerable elevation and in areas apparently disconnected.

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[10] Selected by Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1912, p. 106, (1912).

Localities Represented in Material Examined

Typical *Circotettix rabula rabula*

British Columbia: Glenora. Alberta: Fort McLeod. Montana: Spire Rock, Billings, Forsyth, Powderville and Glendive. Wyoming: Mammoth Hot Springs (*type locality*), Worland, Rawlins, Centennial Valley and Laramie. Colorado: Dutch George, Virginia Dale. Idaho: Salmon City, Henry Lake and Soda Springs. Utah: Logan, Ogden Canyon, Salt Lake Valley and City Creek Canyon.

Atypical *Circotettix rabula rabula* toward *C. rabula nigrafasciatus*

Wyoming: Newcastle. Nebraska: Bad Lands in Sioux County, Gordon.

Intermediates between *Circotettix rabula rabula* and *C. rabula nigrafasciatus*

Manitoba: Aweme, Treesbank. South Dakota: Rapid City, Hot Springs.

Atypical *Circotettix rabula rabula* toward *C. rabula altior*

Wyoming: Heela. Utah: Maple Peak in Salt Lake County, Cedar Mountains in Iron County.

Intermediate between *Circotettix rabula rabula* and *C. rabula altior*

Montana: West Gallatin Canyon. Wyoming: Big Horn Mountains Grade Canyon in Sublette Range. Colorado: Dolores. Utah: Park City Sierra La Sal.

Circotettix rabula nigrafasciatus Beamer (Plate XII, figs. 10 to 12.)

1917. *Circotettix nigrafasciata*[11] Beamer, Bull. Univ. Kansas, XVIII, no. 1, p. 123, fig. 108. [♂ ♀; Kansas (Graham, Rooks, Logan, Gove,. Trego and Barber Counties are indicated on accompanying chart by circles).]

We have before us two male and two female paratypes from Graham, Gove, Rooks and Trego Counties, Kansas, received in exchange from the University of Kansas, Entomological Museum. The typical series consisted of twenty-nine males and sixteen females, according to Beamer.

Single Type (here selected).[12]—♂; Trego County, Kansas. July 12, 1912. (F. X. Williams.) [University of Kansas, Entomological Museum.]

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[11] This spelling, and this only, occurs three different places in Beamer's paper. This is unfortunate, but the concensus of opinion is that the original spelling must be retained, in view of the fact the author uses it consistently in three different places.

[12] Dr. S. J. Hunter has kindly supplied us with these data. This specimen was indicated by Beamer as the type, but only by labelling and not in print, so the present indication is the first published selection

The chief differential features of the present subspecies, among the forms of *rabula*, are generally narrower tegminal apices, average more elongate wings with slightly more acute apices, weaker incrassation of the heavier radiate veins of the wings and the sharply indicated and generally complete and solid dark wing bar. These features other than the wing bar all show some variation in the series before us, and the race is not structurally as definite as *C. rabula altior*. The wing bar, however, is sharp and contrasted in typical material, and less marked and broken in atypical individuals.

This geographical race is a large, generally pale colored, one, typical over a considerable portion of the Great Plains region, particularly in the sandhill country, its area of distribution extending from south-central South Dakota (Capa) south to south-central Kansas (Barber County), west to extreme southeastern Wyoming (Pine Bluffs) and east-central Colorado (Pueblo and Gray Creek). Typically the subspecies is found north only to southeastern Wyoming (Pine Bluffs) and northwestern (Fort Robinson) and central (Dismal River and Broken Bow) Nebraska. Material from Capa, South Dakota is somewhat atypical, while a series of thirty-three of both sexes from Glen, Nebraska comprises mostly atypical individuals, although about twenty per cent are typical of *nigrafasciatus*. In all from Glen the wing bar is nearly typical of *nigrafasciatus*, the fluctuations being in other features. To understand the intergradation of *C. rabula rabula* and *C. rabula nigrafasciatus* in northwestern Nebraska it is necessary to visualize the physiography of the country. The Great Plains plateau there breaks off sharply on the north to the Bad Lands of the Cheyenne and White Rivers. In the latter type of country we find material of this species which is atypical of *rabula rabula*; on the surface of the Plains we find our representatives nearly or quite *rabula nigrafasciatus*, which ranges off to the south over the Plains and sandhills sections, where in preferred environments it occurs as low as 2480 feet (Broken Bow), approximately one thousand feet lower than the country in which atypical *rabula rabula* occurs in the Cheyenne and White River Bad Lands. On the slopes of the Sioux County, Nebraska escarpment, as at Glen, the material shows definite intergradation of the two races. At Capa, South Dakota atypical *nigrafasciatus* occurs as low as two thousand feet. To the westward *nigrafasciatus* is fully typical at least as far as Pueblo, Colorado, nearly at the foot of the Rockies, while material from Gray Creek, Las Animas County, in the same state, at 6500 to 7000 feet, is nearly typical, with some showing weak tendencies toward *C. rabula rabula.*

Localities Represented in Material Examined

Typical *Circotettix rabula nigrafasciatus*

NEBRASKA: Fort Robinson, Sidney, Dismal River, and Broken Bow. KANSAS: Chalk cliffs fifteen miles south of Collyer, Graham County, Rooks County, Gove County and Trego County. COLORADO: Wray, Limon, Pueblo and Gray Creek.

Atypical *Circotettix rabula nigrafasciatus*

SOUTH DAKOTA: Capa. NEBRASKA: Glen.

Circotettix rabula altior[13] new subspecies (Plate XII, figs. 13 to 15.)

This geographic race is a form of the higher parts of the Rocky Mountains and associated systems from northern Colorado to southern New Mexico, apparently occurring in disconnected areas of approximately similar conditions. It is almost entirely a form of the Boreal Zone within that territory, intergrading with true *rabula* to the northward and to the westward at the lower edge of its habitat. Intergradation with *C. rabula nigrafasciatus* has not been definitely established.

The present form may be characterized within the species by having a relatively small head, eyes smaller than in the other subspecies, fastigium narrower, particularly in the female, in the more deplanate metazonal portion of the pronotal disk, the tegmina quite broad and the caudal tibiae darker than in the other forms.

Type.—♂; Cloudcroft, Sacramento Mountains, Otero County, New Mexico. Elevation, 8600 to 8700 feet. June 17, 1902. (H. L. Viereck.) [Academy of Natural Sciences of Philadelphia, Type no. 5378.]

The following features are chiefly comparative with *C. rabula rabula* and *C. rabula nigrafasciatus.* Size small; form as a whole more compressed and less robust. Head proportionately smaller when compared with greatest pronotal width; from cephalic aspect more compressed, greatest width across genae contained one and one-half times in greatest depth of head, instead of approximately one and one-third times as in *rabula rabula:* fastigium appreciably narrower, its greatest width subequal to two-thirds of greater length of same, instead of approximately subequal: eyes smaller, although equally prominent, basal outline more elliptical. Pronotum with strangulation of prozona more decided in proportion to metazonal disk width; metazonal portion of pronotal disk as a whole more deplanate, with lateral (humeral) shoulders more evident and less broadly rounded. Tegmina moderately broad, as a whole more subequal in width, apical section less narrowed. Wings ample.

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[13] Altior—*higher.*

Allotype.—♂; Same data as type. [Acad. Nat. Sci. Phila.]

The female sex shows the same features of differentiation as the male, but the fastigial difference is less decided and the pronotal contrasts not as marked.

Coloration showing no distinctive features of differentiation from the other subspecies, although averaging more infumate or even blackish. Wing bar never solidly marked nor as strongly evident as in *C. rabula nigrafasciatus*, but always of the clouded type, intensified toward the margins and weak mesad, found in *rabula rabula*, distal portion of wing typically weakly infumate. Caudal tibiae with a pale, complete or incomplete, proximal annulus, elsewhere bister to mummy brown, rather pale in postmedian section; tibial spines ochraceous-tawny to pale bister proximad.

Environmental influences on base coloration are evident. Specimens from Evanston, Wyoming, are very pale with occasionally subobsolete wing bars. Glenwood Springs material is as a whole brownish and of a uniform tone. Cloudcroft material and that from Tesuque Creek, in the Santa Fé Rockies, is more uniform blackish, although some of the Cloudcroft series are very pale, as pale as average *C. rabula rabula* from its type locality (Mammoth Hot Springs, Yellowstone National Park). Immediate environment is probably the controlling factor, as is quite clearly the case in certain species of *Trimerotropis*.

Measurements (in millimeters)

♂	Length of body	Length of pronotum	Greatest width of pronotum	Length of tegmen	Length of caudal femur
Cloudcroft, New Mexico, *type*..	21.8	5.5	4.9	27	12.3
Cloudcroft, New Mexico, *paratype*..........................	21.9	6	5	28	12.2
Cloudcroft, New Mexico, *paratype*	21	6	5	28.6	12.6
Tesuque Creek, New Mexico...	23	6.2	5	26	11.4
Tesuque Creek, New Mexico...	26.2	6.1	5.2	30	12.9
♀					
Cloudcroft, New Mexico, *allotype*..........................	27.2	6.9	5.2	28	13.5
Cloudcroft, New Mexico, *paratype*..........................	28.6	6.6	5.4	27.9	13.2
Cloudcroft, New Mexico, *paratype*..........................	32.2	6.7	5.2	28.9	13
Tesuque Creek, New Mexico...	32.8	6.9	5.6	29.2	13.6

We have selected as paratypes a series of fifteen males and sixteen females from the type locality, the data for which are as follows: June 16 to 20, 1902, (H. L. Viereck), [Academy of Natural Sciences of Philadelphia], nine males, four males; July 15, 1907, (Rehn and Hebard), [Hebard Collection and Academy of Natural Sciences of Philadelphia], six males, twelve females. The color variation of this series is very considerable, a few notes on which are given above.

In an atypical condition this race occurs as far northwestward as southeastern Wyoming (Evanston), but the majority of the atypical individuals are from localities along or below the lower border of the Boreal Zone in Colorado and northern New Mexico. Atypical material from Evanston is, as mentioned above, quite pale in coloration. Material from 9700 feet on Pike's Peak is virtually typical, that from Manitou at 6400 to 6700 feet atypical, as is also a Cripple Creek series. An extensive series of twenty-two males and thirty-four females from Glenwood Springs, Colorado is atypical. A single male from Silver Lake, Utah (9700 feet), as would be expected from the elevation, is typical, while three males and four females from Park City, Utah (about 7000 feet) are intermediate between *C. rabula rabula* and *C. rabula altior*. A series of twenty-three males and sixteen females from Jemez Hot Springs, New Mexico, are virtually atypical, although a few could be called intermediates, while a series of the same numbers of individuals of each sex from Fort Wingate, New Mexico, is similar in character. A single female from the Big Horn Mountains, Wyoming is intermediate, as is also one male from West Gallatin Canyon, Montana. A single female from Dolores, Colorado, sixteen males and twenty-six females from Grade Canyon, Sublette Range, Lincoln County, Wyoming, and five males and twelve females from Sierra La Sal, Utah, are clearly intermediates.

Specimens Examined: 197; 103 ♂, 94 ♀.

Typical *Circotettix rabula altior*

COLORADO: Brainerd Park, 10,500 feet, VIII, 28, 1899, 1 ♂, 1 ♀, [Hebard Cln.]. Georgetown, Clear Creek County, 8500 to 9500 feet, VII, 12 to 13, 1877, 1 ♀, [Hebard Cln.]. Tennessee Pass, Eagle County, 10,240 feet, IX, 10, 1909, (R. & H.; occasional on hill slope covered with sage and short scattered grass), 5 ♂, 3 ♀. Mountain View, Pike's Peak, El Paso County, 9705 feet, VIII, 20, 1904, (Hebard), 1 ♂, 1 ♀.[14]

NEW MEXICO: Beulah, San Miguel County, VIII, 17, (H. Skinner), 3 ♂, 1 ♂, [A. N. S. P.]:[15] (W. P. Cockerell), 1 ♂, [A. N. S. P.].[16] Top of Las Vegas Range, San Miguel County, VI, 28, 1902, (H. L. Viereck), 1 ♂, [A. N. S. P.]. Tesuque Creek, west slopes of Lake Peak, Santa Fé Range, Santa Fé County, 7900 feet, VII, 27 to 28, 1919, (R. & H.; in moderate numbers in open gravelly spots or along roads in forest region), 8 ♂, 2 ♀. Rio Ruidoso, White Mountains, 6500 feet, VII, 30, (C. H. T. Townsend), 1 ♂, 1 ♀, [A. N. S. P.]. South Fork of Eagle Creek, White Mountains, 8000 to 8300 feet, VIII, 19 to 20, (C. H. T. Townsend), 2 ♂, [A. N. S. P.]. Cloudcroft, Sacramento Mountains, Otero County, June 16 to 20, 1902, (H. L. Viereck), 10 ♂, 5 ♀, *type*, *allotype* and *paratypes*, [A. N. S. P.]:[17] July 15, 1907, (R. & H.), 6 ♂, 12 ♀, *paratypes*, [Hebard Cln. and A. N. S. P.].[18]

UTAH: Silver Lake, Wasatch Mountains, Salt Lake County, VII, 14, (H. Skinner), 1 ♂, [A. N. S. P.].

Atypical *Circotettix rabula altior*

WYOMING: Evanston, Uinta County, VIII, 2 and 3, 1920, (H. Skinner), 2 ♂, 1 ♀, [A. N. S. P.].

COLORADO: Ward, Boulder County, VIII, 26 to 27, 1901, (L. Bruner), 1 ♂, 1 ♀, [Hebard Cln.]. Swift Creek, Custer County, (Cockerell), 1 ♀, [Hebard Cln.]. Manitou, 6400 to 6700 feet, VIII, 23, 1904, (Hebard), 1 ♂, 1 ♀, [Hebard Cln.]. Cripple Creek, VIII, 19, 1904, (Hebard), 4 ♂, [Hebard Cln.][19]. Glenwood Springs, 5800 to 7100 feet, IX, 9, 1909, (R. & H.; on slopes with juniper and some pinyon, abundant above 6000 feet, particularly in open spots), 7 ♂, 30 ♀; VII, 12, 1920, (H. Skinner), 2 ♀, [A. N. S. P.].

NEW MEXICO: Sandia Mountains, IX, 14, 1909, 1 ♂, [Hebard Cln.]; VI, 14, 1909, (rim rock in oak chaparral), 1 ♂, [Hebard Cln.]. Jemez Hot Springs, Sandoval County, 7500 feet, VIII, 1909, VI, 9, 1914, VI, 24 to 29, VII, 2 to 12, VIII, 8 to 20, IX, 7 to 16, 1912 and 1913, (John Woodgate), 23 ♂, 14 ♀, [Hebard Cln.]. Fort Wingate, McKinley County, VI, 18 to 30, VII, 4 to 31, VIII, 4 to 17, IX, 3 to 25, X, 3, 1910, (John Woodgate), 23 ♂, 17 ♀, [Hebard Cln.].

The Crotalum Group of the Genus Circotettix

Provisionally we are using this group name to include two species having deep glaucous blue caudal tibiae. They possess some other features in common, but, when our study work is better in hand, the association may be found unwarranted and the removal of one of the forms (*crotalum*) to the Shastanus Group necessitated. The species *coconino* very nearly approaches *C. rabula altior*, in fact in some respects seems almost a replica of it, with certain differences discussed below, and through these two entities it would seem that the common ancestry of these groups (i. e. the Rabula Group and the Crotalum Group) is evident. Groups we are calling these, as they can readily be distinguished by the yellow to brownish caudal tibiae of the Rabula assemblage, and the deep glaucous blue of the one here treated; also we have no evidence that *rabula* and *coconino* intergrade, although such may be the case. The true position of *crotalum*, as intimated above, may be found eventually to be in the Shastanus Group, the forms of which at present so placed have paler glaucous caudal tibiae. However, at this writing the association of *coconino* and *crotalum* seems best, particularly as *shastanus* has a much more complex secondary venation of the wings, a single axillary vein in the same and a more compressed general form. From *splendidus*, another member of the Shastanus Group, the slender general form will at once separate *crotalum*.

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[14] Recorded by Rehn and Hebard (Proc. Acad. Nat. Sci. Phila., 1906, p. 393, (1906)) as *Circotettix undulatus*.

[15] Recorded by Rehn (Ibid., 1902, p. 722, (1903)) as *Circotettix undulatus*.

[16] Recorded by Rehn (Ibid., 1904, p. 569, (1904)) as *Circotettix undulatus*.

[17] Recorded by Rehn (Proc. Acad. Nat. Sci. Phila., 1902, p. 722, (1903)) as *Circotettix undulatus*.

[18] Recorded by Rehn and Hebard (Ibid., 1909, p. 154, (1909)) as *Circotettix undulatus*.

[19] Recorded by Rehn and Hebard (Ibid., 1906, p. 393, (1906)) as *Circotettix undulatus*.

Circotettix coconino new species (Plate XII, figs. 19 to 21.)

A stocky robust form, with relatively short and broad tegmina and but little distal prolongation of the wings, the distal margin of the axillary field of the same well arcuate. Looking much like a deep glaucous blue tibiaed *C. rabula altior*, it, however, can be separated by the greater width proximad of the area of the median forks of the wing, which region is, by virtue of the shorter wings, much shorter and with fewer cross-veins. The eye, in basal outline, is also more elliptical and not sub-ovoid. The differences from *C. crotalum* are given under that species.

Type.—♂; Bill Williams Mountain, Coconino County, Arizona. September 14, 1917. (O. C. Poling.) [Hebard Collection, Type no. 767.]

Size medium; form robust (for the genus).

Head relatively narrow, greatest width across genae contained slightly less than one and one-half times in greatest depth of same; in profile with occiput and fastigial outline markedly bullato-arcuate, fastigio-facial angle narrowly rounded obtuse, faintly projecting: fastigium moderately broad, roughly flask-shaped, greatest width contained one and two-fifths times in greatest length of same, lateral margins decided, moderately elevated, median carina distinct, less decided than lateral, continued weakly over occiput; lateral foveolae slightly elongate, trigonal, well impressed; frontal costa moderately broad, appreciably narrowed dorsad at junction with fastigium, where surface is impresso-foveolate; surface of costa deeply impressed about and for a distance ventrad of median ocellus; lateral carinae appreciably constricted at level of lower margin of median ocellus, markedly diverging thence ventrad. Eyes faintly elevated dorsad of fastigium seen from cephalic aspect, moderately prominent, large, in basal outline broad subelliptical-ovate.

Pronotum of type usual in genus, prozonal strangulation evident, although not pronounced; length of metazonal disk nearly twice as great as that of prozona, greatest width of metazonal disk equal to length of same with half of prozonal length: cephalic margin of pronotum faintly produced, caudal margin rectangulate with immediate angle very narrowly rounded; median carina evident but delicate and not markedly elevated, weakening caudad; surface of metazonal disk as a whole deplanate but showing some undulation in profile, cribroso-reticulate: transverse sulci well impressed: humeral metazonal shoulders distinct, faintly carinate cephalad. Lateral lobes of pronotum with their greatest dorsal length faintly less than greatest depth of same.

Tegmina surpassing apex of abdomen by approximately length of pronotum, broad, greatest width contained about four times in length of same: costal margin as a whole subarcuate with median flattening; distal margin obliquely subtruncate: intercalary vein decided, proximad equidistant from median and ulnar veins: anal field broad, at widest point nearly equal to two-fifths of greatest tegminal width. Wings relatively short and broad, depth of wing contained slightly under one and one-half times in greatest breadth of same, apical section moderately angulate, distal margin of anterior field oblique subtruncate, apex not at all falcate; axillary field with its peripheral margin moderately arcuate; peripheral margin of radiate field arcuately scalloped between subjacent radials: venation open and cross-veins relatively few; area of median forks quite broad proximad, narrowed distad, posterior branch proximad very closely approaching ulnar vein; ulnar vein as a whole moderately arcuate, ulnar area over twice as wide, at widest point, as adjacent portion of medio-ulnar area: posterior axillary vein weak; first, second and third superjacent radials incrassate.

Mesosternum with interspace slightly transverse, faintly narrower than width of one of the mesosternal lobes; metasternal interspace no wider than mesosternal, but shallower, and in consequence more transverse.

Caudal femora with apices almost reaching to apex of abdomen.

Allotype.—♀; Same data as type. [Hebard Collection.]

The characters here given are those of importance which differ from the description of the same features in the male sex.

Head faintly broader across genae. Fastigio-facial angle slightly less angulate than in male; fastigium faintly broader, median carina slightly less evident than in male; frontal costa of form similar to male but broader throughout.

Tegmina surpassing apex of abdomen by approximately three-fourths of pronotal length, greatest width contained about four and one-quarter times in length of same. Wing with ulnar area at widest point equal to twice width of medio-ulnar area; incrassation of axillary and three superjacent radials extremely slight.

Caudal femora with apices falling short of abdominal apex by faintly more than metazonal length.

General color as seen from dorsal surface dull cinnamon brown to deep mummy brown, the tegmina with three generally indistinct, irregular and incomplete transverse clouds of mummy brown to blackish areolate spots, the proximal cloud more evident than the others, the distal very much diffuse, and all variable in strength and opacity, although never solid nor in contrasting evidence. Disk of metazona occasionally solidly touched with ochraceous-tawny, this rarely well contrasted; rarely the entire pronotum has an overlay of fine blackish speckles. Lower face, lower portion of genae and mouth-parts passing from the dorsal color to drab gray to mouse gray. Eyes buckthorn brown to russet and prout's brown. Antennae obscurely multiannulate with ferruginous to tawny. Wings with disk naples yellow (rarely to citron yellow; transverse bar never solid or sharply defined), always nebulose, weak mesad and more intense along or near the first, second and third superjacent radials and in the region of the humeral spur, in color the bar is mummy brown; distal section of wing very weakly infumate. The axillary, first, second and third superjacent radial veins may have their sections within the bar strongly infuscate with mummy brown, or the yellow of the disk may continue along the vein itself for some distance toward the peripheral margin. Ventral surface blackish brown; paired subcircular areas of wood brown to buffy brown usually indicated on the mesosternal-mesopleural suture and laterad on the metasternum. Caudal femora with ventral sulcus solidly black except for a pregenicular pale ochraceous-tawny annulus, which is but weakly evident on the dorsal and lateral faces; dorsal and lateral faces with indications of the usual dark bars. Caudal tibiae acetin blue to tyrian blue, rarely as greenish as gobelin blue, passing to ochraceous proximad and there black clouded on internal face; tibial spines black tipped; caudal tarsi pale ochraceous-salmon to ochraceous-buff, dorsally marked with glaucous.

Measurements (in millimeters)

♂	Length of body	Length of pronotum	Greatest width of pronotum	Length of tegmen	Greatest width of tegmen	Length of caudal femur
Bill Williams Mountain, Arizona, *type*........	27	6.3	5.5	25.8	6.6	13.2
Bill Williams Mountain, Arizona, *paratype*....	26.4	6.3	5.5	25.1	6.3	13

	Length of body	Length of pronotum	Greatest width of pronotum	Length of tegmen	Greatest width of femur	Length of caudal femur
Bill Williams Mountain, Arizona, *paratype*	25	6.1	5	25.4	6	12.4
Bill Williams Mountain, Arizona, *paratype*	24.6	5.6	5	25.5	6.2	12.1
San Francisco Mountains, Arizona	25.6	6.3	5.6	26.6	6.3	12.9
Dewey, Arizona	26.5	5.8	5.1	24.9	6	12.8
Bright Angel, Arizona	27.8	6.6	5.7	29.6	7	14
Bright Angel, Arizona	27.5	6.9	5.8	29.4	6.8	13.4
♀						
Bill Williams Mountain, Arizona, *allotype*	29.5	6.3	5.5	26.7	6.2	13
Bill Williams Mountain, Arizona, *paratype*	33.2	7.2	5.6	31	6.8	15.2
Bill Williams Mountain, Arizona, *paratype*	32.4	7	5.8	29.5	6.5	14.7
Bill Williams Mountain, Arizona, *paratype*	31.4	7	6	30.2	7.1	15.1
San Francisco Mountains, Arizona	32.5	7	5.7	31.2	7	13.9
Bright Angel, Arizona	32.5	7	5.9	31	7	14.5
Bright Angel, Arizona	33.4	7.3	5.9	32.5	7.1	14.6

We have selected as paratypes a series of fourteen males and twenty females bearing the same data as the type. This series, as a whole, is relatively uniform in size, and in the features of the species. The wing bar shows some variation in intensity and solidity, in general its fluctuation is solely one of intensification or recession, and its area remains the same and its margins as lacking in sharp definition.

Material of the species from Bill Williams Mountain, Flagstaff, San Francisco Mountains and Dewey is uniform in character, of similar general proportions, wing structure and pattern. The fastigium varies somewhat in width in the above series, but it is rarely sufficiently narrow to cause any confusion with *C. crotalum*, and in such cases the general, pronotal and tegminal features are diagnostic.

A series of nine males and ten females from the vicinity of the rim of the Grand Canyon at Bright Angel, Arizona, show a more elongate type of tegmina and wings than those from the other localities represented. This produces a generally more elongate appearance and an appreciable approach toward *C* *crotalum*, but this tendency is, apparently, not sufficient to indicate intergradation, although a representation from more localities in northern and northeastern Arizona may show such to be the case. Further collecting in that region must be done to clearly determine this matter.

The species inhabits open park-like areas scattered through forests of western yellow pine (*Pinus ponderosa*) in northern Arizona. Its clattering is very decided.

Specimens Examined:[20] 59; 27 ♂, 32 ♀.

ARIZONA: Bright Angel, Grand Canyon of the Colorado, Coconino County, 7000 feet, IX, 11, 1907, (Hebard), 5 ♂, 5 ♀, [Hebard Cln. and A. N. S. P.][21]: 6880 feet, VII, 29 to VIII, 2, 1906, (P. P. Calvert; on rim of canyon), 3 ♂, 2 ♀, [A. N. S. P.]: X, 6, 1919, (Hebard; in open park-like yellow pine forest in shallow valley back from edge of canyon), 1 ♂, 2 ♀: VII. 11, 1905, (H. Skinner), 1 ♂, [A. N. S. P.]. San Francisco Mountains, Coconino County, 9000 feet, VII, 31, 1919, (R. & H.; in bare spots at upper limit of yellow pine forest), 1 ♂, 1 ♀. Flagstaff, Coconino County, VII, 3, 1 ♂, [Hebard Cln.]. Bill Williams Mountain, Coconino County, IX, 14, 1917, (O. C. Poling), 15 ♂, 21 ♀, *type, allotype* and *paratypes*, [Hebard Cln. and A.N.S.P.] Dewey, Yavapai County, IX, 9, 1917, (O. C. Poling), 1 ♂, [Hebard Cln.].

Circotettix crotalum[22] new species (Plate XII, figs. 16 to 18.)

We have discussed above the general relationship of this species, and specific comparison here need be made only with *C. coconino*, described above, and *C. shastanus* Bruner. From *coconino* the present species differs in its more slender and elongate form, narrower fastigium, slightly more angulate fastigio-facial angle, slightly less prominent eyes, more elongate tegmina, with narrower anal field, more elongate and apically falcate wings, and the average greater development of the first, second and third superjacent radials of the wing. The caudal femora also average more robust. From *shastanus* the present species differs in its relatively more robust build, relatively larger head, somewhat broader anal field of the tegmina, the more falcate wing, which has two instead of a single axillary vein and a more open venation, and in the darker glaucous tone of the caudal tibiae. *Shastanus*, typically, is a more compressed insect with a smaller head in proportion to the prozonal section of the pronotum.

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[20] In addition to these specimens we have three males labelled "Albuquerque, N. Mex. 7-12-02. Oslar" (recorded as *Circotettix undulatus* by Rehn, Proc. Acad. Nat. Sci. Phila., 1904, p. 569, (1904)). These are clearly *coconino*, probably from some point in north-central Arizona, but certainly from nowhere near Albuquerque, New Mexico. At the previous writing Albuquerque was queried as the exact locality, but it is evident the locality is more erroneous than at first supposed.

[21] Recorded by Rehn and Hebard (Proc. Acad. Nat. Sci Phila., 1908, p. 391, (1908)) as *Circotettix undulatus*.

[22] I. e. *a castanet*.

Type.—♂; Lee Canyon, Spring Mountains, Clark County, Nevada. Elevation, 8000 to 8500 feet. August 19, 1919. (Rehn and Hebard.) [Hebard Collection, Type no. 768.]

Size medium; form elongate, slender, body moderately compressed.

Head of average size, moderately deep in proportion to width, greatest width across genae contained one and one-half times in greatest depth of head: fastigium narrow, its greatest width contained slightly more than one and one-half in length of same, relatively open caudad, shallowly excavate with obscure median carina; fastigio-facial angle moderately produced, more evident than in *C. coconino:* frontal costa broad, narrowing dorsad, faintly constricted ventrad of median ocellus, obsolete on lower face, shallowly impressed about median ocellus, excavate for brief distance ventrad of same; lateral foveolae each an equilateral triangle in outline, very shallowly excavate. Eyes hardly prominent from cephalic aspect, hardly elevated, basal outline subovoid.

Pronotum moderately strangulate, greatest width across metazonal disk subequal to metazonal and one-half of prozonal length; metazona nearly twice as long as prozona: caudal margin of disk as a whole rectangulate, immediate angle rounded; median carina low but distinct, transverse sulci evident; metazonal disk weakly undulate: humeral angles of metazonal disk prominent but narrowly rounded. Lateral lobes of pronotum with greatest depth subequal to dorsal length.

Tegmina elongate, surpassing apex of abdomen by faintly more than length of head and pronotum combined, broad, greatest width contained slightly more than three and one-third times in the greatest length of same, appreciably narrowing in distal fifth, distal margin obliquely subtruncate; intercalary vein proximad equidistant from median and ulnar veins: anal field moderately broad, but distinctly narrower than in *C. coconino*, in greatest width (to anal vein) equal to less than one-third of greatest tegminal width. Wings moderately elongate, depth of wing contained one and three-fifths times in greatest breadth of same; apical section moderately falcate, distal margin of anterior field oblique subtruncate; axillary field with its peripheral margin oblique and weakly arcuate; peripheral margin of radiate field similar to but more weakly scalloped than in *C. coconino:* venation more complex and cross-veins more numerous than in *C. coconino:* area of median forks broad, narrowing distad, similar to same area in *coconino* but more elongate and its expansion less pronounced; ulnar area nearly three times as wide, at widest part, as adjacent portion of medio-ulnar area; posterior axillary vein weak, but still more evident than in *C. coconino*; first, second and third superjacent radials metassate, the last more appreciably so than the others.

Caudal femora with apices falling short of apex of abdomen by faintly less than prozonal length.

Allotype.—♀; Same data as type. [Hebard Collection.]

The characters are those of importance which differ from the description of the same features in the male sex.

Head slightly broader across genae. Fastigio-facial angle distinctly less angulate than in male, the fastigial line in profile arcuate.

Tegmina surpassing apex of abdomen by length of pronotum, greatest width contained four and one-half times in greatest length of same: incrassation of anterior axillary vein, first, second and third superjacent radials extremely slight.

Caudal femora with apices falling short of abdominal apex by no more than the metazonal length.

Measurements (in millimeters)

♂	Length of body	Length of pronotum	Greatest width of pronotum	Length of tegmen	Greatest width of tegmen	Length of caudal femur
Lee Canyon, Nevada, 8000–8500 ft., *type* ...	27.5	6.2	5.4	30.7	7	13
Lee Canyon, Nevada, 7200 ft., *paratype*	25	5.7	4.6	28.5	5.7	11.5
Lee Canyon, Nevada, 7200 ft., *paratype*	26.4	5.8	4.8	32	6.1	12.7
Charleston Peak, Nevada, 10,200 ft., *paratype*	26	6	5	31.5	6.5	12.9
♀						
Lee Canyon, Nevada, 8000–8500 ft., *allotype*	29.2	6.4	5.5	32	7	13.1
Lee Canyon, Nevada, 7200 ft., *paratype*	30[23]	5.4	4.8	27.4	5.5	12.2
Lee Canyon, Nevada, 8000–8500 ft., *paratype*	35.6[23]	7	5.8	33	6.2	14.1
Charleston Peak, Nevada, 10,200 ft., *paratype*	30.9	6.4	5.3	31.6	6.5	13.5

General color impression of dorsal and lateral surfaces ranging from drab or cinnamon-drab to nearly fuscous black, the whole general tone produced by an obscure "salt and pepper" mottling of light drab or ecru-drab to cinnamon-drab and mouse gray, with hair brown to blackish brown, the tegmina with the dark suffusions areolate and hardly distributed in the usual transverse bars, or at best obscurely so. Face and occasionally genae of the pale tone of the general mottling. Eyes buckthorn brown to prout's brown. Antennae obscurely annulate with the two tones of the general mottling.

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[23] Slightly abnormal in abdominal extension.

Wings with disk chalcedony yellow to amber yellow (in vast majority), rarely naples yellow; bar similar to that of *C. coconino* in form and extent, but more uniform in intensity, more solid and generally more sharply defined, in color mummy brown; distal portion of wings ranging from clear hyaline to very faintly infumate. Ventral surface ranging from isabella color and light brownish olive to fuscous-black with a wash of dusky dull bluish green; pale areas described on sternum of *C. coconino* indicated, but not invariably, in this species. Caudal femora with color as described for *coconino,* caudal tibiae deep orient blue to dark tyrian blue, otherwise as in *C. coconino,* caudal tarsi pinkish buff, lined dorsad with bluish.

We consider as paratypes the entire series before us (other than type and allotype)—forty-two males and fifty-four females, taken in Lee Canyon, Spring Mountains, Nevada, August 18 to 20, 1919, at elevations of from 7000 to 8500 feet, and one male and two females taken at 10,200 feet on Charleston Peak, Spring Mountains, Nevada, on August 19, 1919, all secured by Rehn and Hebard. This series shows, as is demonstrated in the above table, that the species varies individually very greatly in size, even at the same elevation in Lee Canyon; also that the form of the fastigium varies considerably in shape and in the relative proportions of the same, although this area is, when the series is considered as a whole, of a distinctly narrower type than in *coconino.* The basic coloration is variable, as the color description shows, but there appears to be some environmental correlation here. The material taken from seven thousand to seven thousand, two hundred feet is paler, more grayish in general tone; that from eight thousand to eight thousand, five hundred feet is more blackish,[24] as is also that from Charleston Peak. This is probably due to responses to some environmental influences at the two localities. At seven thousand, two hundred feet we have a park-like region, of juniper and pinyon with sage brush, and open areas showing some bare gray limestone, much sunlight and strong reflection; at eight thousand to eight thousand, five hundred feet we have a region of yellow pine forest with small glades and some cut-over areas, but as a whole one of shadows and reduced light, with the limestone of the mountains largely mantled with needles and dry soil.

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[24] Several individuals from this elevation are as pale and as grayish as those from seven thousand, two hundred feet. In one case this is clearly due to the specimen being teneral, and a similar cause may be responsible for the others, although from our knowledge of the immediate locality restricted sections approximate the conditions found at seven thousand, two hundred feet.

The species is known only from the Spring Mountains of southern Nevada, an isolated mountain mass which rises from the surrounding desert valleys, i. e. Indian Spring on the north, Las Vegas on the northeast and east, Mesquite and Ivanpah on the south, Pahrump on the southwest and the Amargosa Desert on the west. The general level of these valleys is two thousand to three thousand, five hundred feet above sea-level, and the summit of Charleston Peak, the culminating point of the Spring Mountains, reaches eleven thousand, nine hundred feet. Ascending from the northeast, up Lee Canyon, by way of an old traction road over which timber had been hauled from a now abandoned saw-mill, we first encountered the present species of oedipodid at seven thousand feet, in a park-like region of juniper and pinyon, where on bare spots with broken stony soil, often with dry scattered grass and low herbage, it was uncommon. From this elevation up it increased in local abundance. At eight thousand to eight thousand, five hundred feet in very dry open forest of western yellow pine, some douglas fir and western white pine, the insect was moderately numerous, preferably on bare surfaces with pebbles and large fragments of the blue gray limestone of which these mountains are largely composed. While a powerful flier, *crotalum* is not easy to capture chiefly for another reason, as, while not particularly wary, it has a crouching habit which permits a net to pass over it before, rising safely, it rattles off. It clatters much like members of the Rabula Group, but not quite so loudly, and in flight seldom rises more than a dozen feet, apparently not performing the aerial ballet of *C. undulatus* (*lobatus* of authors). As high as ten thousand, two hundred feet on the very steep and rocky slopes of Charleston Peak, *crotalum* was found, although there but a single colony, and this largely made up of immature individuals, was located on August 19.

Doubtless this insect occurs at suitable elevations and in proper environments on other ranges in southern Nevada, and probably adjacent desert ranges in California, but we are without definite positive information, although negative evidence, from our own observations, is available from certain localities in that general region.